



Northern Rhodesia

Department of Agriculture

ANNUAL REPORT

for the year

1945

1946

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LUSAKA

STAFF LIST AS AT 31st DECEMBER, 1945

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Department of Agriculture

ANNUAL REPORT FOR THE YEAR 1945

The issue of agricultural statistics forms to European farmers has been suspended during the war period. Reliable figures of the quantities of the more important crops produced for sale by farmers are, however, available from other sources.

AGRICULTURE IN THE TERRITORY.

1. The season was the most favourable one for food crops for many years.

Maize : Railway Belt.

2. Maize production on European farms exceeded the record established in 1936. The total crop was approximately 350,000 bags, of which 273,000 bags were delivered to the Maize Control Board. The average yield was nearly eight bags per acre. As with the other bumper harvest of 1936, the early part of the season caused some anxiety. In the event, the semi-drought conditions by stimulating root development were beneficial to the young maize which responded remarkably when the rains became more regular and copious. An even larger crop would have been reaped had a final shower fallen at the end of March.

3. While the season is always the main factor in maize production, considerable credit must be given to the response to the food production campaign. The European maize area has increased by approximately 10,000 acres since 1941, and much of the new land is highly productive.

4. More than half the crop was produced by 30 large growers. Most of these growers have adopted the "alternate lands" system under the rotation maize : green manure (mainly sunnhemp). They consistently obtain high yields.

5. The native-grown crop was also remarkably good. The switch-over to kaffir-corn, reported last year, has been checked.

6. The following table shows maize production for sale in the railway belt, exclusive of a considerable volume of inter-village trade, during the past five years. The figures refer to calendar years and do not tally exactly with those for maize handled by the Maize Control Board in the pool years.

MAIZE PRODUCTION FOR SALE.

(Thousands of bags.)			
<i>Year of Harvest</i>	<i>European</i>	<i>Native</i>	<i>Total</i>
1941	120	38	158
1942	146	51	197
1943	144	60	204
1944	212	115	327
1945	273	202	475

7. In addition to the 475,000 bags received from the railway belt, 8,000 bags were sent in from distant areas. The Civil Supplies Department also purchased 12,000 bags of locally grown kaffir-corn. Nine thousand bags of maize were imported from Angola.

8. Total (exclusive of farm) consumption exceeded 500,000 bags. The supply position was satisfactory as an adequate "carry-over" was available from the former year.

Wheat.

9. Wheat production again increased. 25,563 bags were sold from a total crop of over 27,000 bags. Production was considerably in excess of double the average pre-war figure.

Potatoes.

10. Production has increased considerably in recent years and now approximates to consumption, though few locally grown potatoes are available in August, September and October. The total quantity of locally grown potatoes handled by the Civil Supplies Department during the year was 15,700 bags. Production for sale before the war rarely exceeded 5,000 bags.

Tobacco : Eastern Area.

11. The season was not a particularly favourable one for flue-cured Virginia tobacco and the quality of the crop was, on the whole, below average. The total crop amounted to 2,207,000 lb., representing an average yield of about 424 lb. per acre. On the auction floor 1,894,000 lb. of non-quota tobacco were sold at an average of 11.8 pence per lb., and 305,000 lb. of quota tobacco at an average of 51.9 pence per lb. The overall average for auction floor sales was 17.38 pence per lb.

12. In addition the Eastern Area produced 20,000 lb. of Turkish tobacco and 31,000 lb. of Western sun and air cured.

Tobacco : Western Area.

13. Virginia flue-cured tobacco production in the Western Area has stagnated for some years, partly on account of marketing difficulties and partly due to the greater attraction of Turkish tobacco. The total crop sold was 243,000 lb., representing a yield of approximately 470 lb. per acre. The bulk of the leaf was sold through the Northern Rhodesia Tobacco Co-operative Society at an overall average price of 20.7 pence per lb.

14. In contrast with Virginia flue-cured, Turkish tobacco production is increasing with remarkable rapidity. 403,000 lb. of leaf were sold at good prices during the year, approximately five times the quantity sold last year. An even more satisfactory feature was the quality of the crop produced. Approximately 88 per cent. fell into the "American grades," the standards of which are high. This would be regarded as a remarkable achievement even in a long-established industry.

15. A Turkish Tobacco Association has been formed comprising all growers, and towards the end of the year the majority of growers joined a Turkish Tobacco Co-operative Society. Advisory tours by Southern Rhodesia experts were arranged by the Association and the cost was defrayed by Government.

Rubber.

16. The department continued to purchase, check-grade and despatch wild rubber to the Union of South Africa. The following rubber was received :

Description	Grade	Lb. received	Price per lb. f.o.r. Mazabuka	
			s.	d.
Tapped Sheet	S.T.1	4,872	2	6
	S.T.2	1,282	2	0
	S.T.3	98	1	3
Tapped Ball	T.1	394	2	3
	T.2	998	1	9
	T.3	444	1	0
Bark Rubber	B.1	104,991	2	0
	B.2	124,167	1	6
	B.3	3,015	0	9
	Undergrade	3,344	0	6
Total		243,605 lb.		

17. Production by districts during the rubber campaign has been :

District	1943	Production (short tons)			Total
		1944	1945		
Balovale	4.5	58.6	33.1		96.2
Mwinilunga	16.7	26.8	37.8		81.3
Mankoya	4.6	12.6	28.2		45.4
Mongu	3.3	5.5	7.0		15.8
Sesheke	5.1	1.3	2.4		8.8
Kalabo	—	3.5	2.6		6.1
Senanga	1.2	2.6	2.2		6.0
North-Eastern Districts	5.3	6.6	8.5		20.4
Totals	40.7	117.5	121.8		280.0

18. The three years of the campaign have thrown a great burden on District Officers. There was understandably little spontaneous response from native producers, for the laborious methods of hand extraction did not receive adequate cash compensation in comparison with rates for unskilled labour in the districts. Production, pitifully small though it was, compares favourably with that of most other African territories which attempted to produce wild rubber under similar conditions. It was indeed a remarkable achievement when the scanty and scattered population available for collection is borne in mind. The relief afforded by the cessation of the campaign was considerable. It is only hoped that the great expenditure of effort involved has been worthwhile.

Beeswax.

19. Exports of beeswax increased considerably owing to a favourable bee-season and high prices. The bulk came from Balovale and Mwinilunga districts. The beeswax industry stagnated at a very low level until, some years ago, its possibilities were realised and a campaign of propaganda and instruction was started. The product is one which, even at the pre-war level of prices, could stand

transport from distant areas and it is particularly suited to regions of sparse population. The progress of the industry is indicated by the following figures of exports :

Year	Cwt. exported
1928-34	11 (average)
1935	73
1936	500
1937	997
1938	600
1939-41	(not known)
1942	950
1943	770
1944	817
1945	1,757

The price f.o.b. South African ports was stabilised at £8 15s. 0d. per cwt. in 1943. Pre-war prices ranged round £5 per cwt.

The Red Locust (*Nomadacris septemfasciata*).

20. No movements of any importance were reported within the Territory and there was no damage to crops. Considerable anxiety existed, however, as a result of massed breeding in the Rukwa outbreak-area beyond our north-eastern border. The International Red Locust Control Organisation destroyed many hopper swarms in this area but there were some escapes, the main direction of the swarms being northerly. A conference of Locust Officers, presided over by the Assistant Director and attended by Dr. Uvarov, Director of the Anti-Locust Research Centre (London), was held at Lusaka in September to consider the existing position and to make plans for the future. It was decided to intensify the campaign in the Rukwa region in the coming season and to recommend that active measures be taken to destroy hopper swarms which occurred in the various territories as a result of the escapes from Rukwa in 1945. In preparation for a possible campaign in Northern Rhodesia 15 tons of *Gammexene* were imported. Happily this was not required locally, and most of it was despatched to the Rukwa area where supplies were running short.

THE WORK OF THE DEPARTMENT.

21. During the year the staff position deteriorated. No new appointments were made and two Agricultural Supervisors resigned. For several months the headquarters office was without a typist.

At the end of the year the European establishment was :

Approved	Actual	
1	1	Director.
1	1	Assistant Director.
1	1	Ecologist.
3	3	Senior Agricultural Officers.
10	8	Agricultural Officers.
2	Nil	Senior Agricultural Supervisors.
10	5	Agricultural Supervisors.
4	4	Clerks (three part-time only).

22. Maintenance of existing programmes put a heavy strain on a staff depleted by sickness and leave movements, wearied by too heavy a burden of work during the war years, and often handicapped by lack of materials. Not the least of the many skills required of an Agricultural Officer in the out-districts is that of motor mechanic. The amount of work which could be done often depended on the length of time the wheels of some ancient and decrepit vehicle could be kept turning.

23. Forestry continued to be administered as a sub-department, but a step toward the long-overdue establishment of a separate Forestry Department was taken during the year when Mr. C. E. Duff was promoted to Senior Assistant Conservator. His report is attached.

24. The Ecologist's 1 : 1,000,000 soil-vegetation map has been with the lithographers for some months but the final printing is unlikely to be made before the middle of 1946.

25. The Ecologist participated in the inquiry into Tonga land tenure and usage and, in conjunction with the Secretary of the Native Land Tenure Committee, toured the Bangweulu region, where observations were made on the serious inundation of agricultural land which has resulted from the recent high water levels in the swamps.

European Agriculture.

26. Wheat variety trials were continued at the Lusaka Station and will form the subject of a separate report for distribution among wheat growers. The farm acquired for the Station early in 1944 was in a shockingly eroded and depleted condition. The average yield of the 1944 wheat crop was less than three bags per acre. As a result of the ameliorative measures employed, the average yield in the 1945 season was raised to 6.5 bags per acre.

27. The Senior Agricultural Officer, Lusaka, when not engaged for brief intervals at the Lusaka Station, was constantly on tour between Mazabuka and Broken Hill and paid 236 advisory visits to European farms. During several of these visits advice on Turkish tobacco culture was given. He laid out furrows and protection work on 875 acres of irrigation land and a further 1,000 acres of irrigable land were surveyed. Soil conservation works were laid out on 4,400 acres of dry lands.

28. The Senior Agricultural Officer, Pemba, in addition to his work among the Tonga, paid several advisory visits, mainly in connection with tobacco growing, to European farms south of Mazabuka.

29. At the Msekera Station (Eastern Province) the following varieties of flue-cured Virginia tobacco were grown for seed at the request of planters: *Bonanza*, *Willow Leaf*, *White Stem Orinoco*, *Jamaica Wrapper* and *Gold Dollar*. *Yellow Mammoth* was also included in the 1945-46 programme. Twenty-three pounds of tobacco seed were sold to planters and a further 21 lb. of planters' own seed was blown and disinfected. Rotation, variety and spacing trials were instituted but no results will be obtainable for some time. Plots were laid out to test the effect of early and late burning on woodlands. A firewood-cutting demonstration was also established.

Native Agriculture.

30. With development plans so much to the fore, it seems fitting that some space should be devoted in this report to a general review of native agriculture and its problems. In Northern Rhodesia we are in the unique and fortunate position of having completed a comprehensive ecological survey *before* having to compile long-term development plans on a scale rendered possible by the recent provision of substantial funds. The survey provides the pattern of soil types and agricultural systems and reveals in their true perspective the multifarious problems. It affords a scientific basis for efficient planning. Its practical application in the Eastern, Central and Western Provinces has occupied much of the time of the Assistant Director during the last five years and I am indebted to him for the racy general review which follows (paras. 31 to 41).

31. "The African population of Northern Rhodesia may number about one and three-quarter millions, distributed irregularly over an area which exceeds 290,000 square miles. Within this area there are an astonishing number and variety of agricultural systems, varying from the simplest form of axe-agriculture (*chitemene*) to complex and highly developed methods of land usage. The system of the Lozi, for example, with its complex of wet, moist and dry gardens and traditional use of cattle manure, differs more widely from the primitive axe-agriculture of their comparatively near neighbours, the Lala, than does the agriculture of Western Europe from that of China. Some tribes appear to be fairly recent converts to agriculture, at least in its present form; among them the Lamba, who still preserve the reputed head of Chief Chipempe, traditionally the bringer of the first seeds and the earliest knowledge of agriculture. They, and some neighbouring tribes, have much more faith in the power of Chipempe's head to bring fertility to the fields, than in all the works of the Agricultural Department.

32. "The study and understanding of these traditional systems of land usage is a first essential to agricultural work among Africans. In this direction much progress has been achieved as a result of deliberate and systematic survey. The ecological survey of the Territory provided a parallel study of the land and the systems employed on it. As a result of this work, a new technique has been evolved for the estimation of the population-carrying capacity of different classes of land, and this knowledge has already been applied on a very considerable scale to the solution of practical problems.

33. "There is a definite limit to the number of people who can obtain their food from a given area of land (we are beginning to realise the limitations of the world's land resources); an absolute limit is set by uncontrollable factors of soil and climate, and a practical limit is set by the method of land usage. If this practical limit, or 'critical population,' is exceeded, a cycle of degenerative changes is set in operation. Degeneration may take the form of erosion, as the word is generally understood, or it may take less obvious and spectacular forms, such as woodland degradation under systems of axe-agriculture. In any case, the result is that the system gradually becomes impracticable, and gives place to modifications which generally hasten the process of degeneration.

34. "The weakness of most African systems of land usage is not that they are destructive of land, but that they allow of only relatively low population densities. Some idea of these critical population densities, for typical Northern Rhodesian systems and soils, may be gained from the following estimates obtained from recent detailed studies. The soil selection systems of the Ngoni, Chewa, Nsenga and Lamba have almost the same average carrying capacity of about 22 persons per square mile for large areas where the systems are practised. The *semi-chitemene* system of the Swaka will allow a mean density of about 12 per square mile, while in the case of the mixed system of the Western Lala, with its more extensive use of woodland, the critical density is about 7 per square mile. The primitive small-circle *chitemene* of the Wisa and Eastern Lala will probably maintain no more than 4 or 5 to the square mile. At the other extreme the stronger soil types, used under traditional soil selection methods, have high carrying capacity of the order of 120 people to the square mile, and in some cases probably more.

35. "Over large areas of Northern Rhodesia population densities are still below the critical point for the systems employed, and often this critical point is unlikely to be reached for fifty years or more. That is not to say that all is well in these areas. Sparse, scattered populations are a barrier to development and, even with more than ample land, the systems often show degenerative changes which

have their root in social and economic causes. The most important of these causes is the depletion of village man-power caused by migration to the mines and other centres of employment.

36. "Elsewhere, over areas large in the aggregate, historical, economic and other factors have brought about population concentrations greatly in excess of the critical densities, and these conditions have already led to dramatic degeneration and rapid land destruction.

37. "It is too commonly and too easily assumed that such problems can be solved simply by teaching the African 'good agriculture'—much as one would teach him to play the piano. The piano-playing analogy is not unapt, for in order to play the instrument one requires skill, a piano and a suitable environment. Skill can be taught in time, if the pupil is sufficiently willing and receptive, but the teaching will have little point if the pupil has neither a piano nor much chance of obtaining one, and if he lives among neighbours allergic to piano-playing.

38. "In other words, for analogies become involved if pursued too far, advanced methods of agriculture require skill in new techniques and material and economic resources commonly beyond the present reach of the majority of Africans. Any considerable change in methods of land usage and land holding may affect, and tend to disrupt, the social organisation of the people; and such changes are usually opposed by the bulk of public opinion. Resistance to change may also be accentuated by the vicious circle of deficiency of energy and food. Better gardens and more food means more work; but a greater energy output requires more and better food in the first place. The problems of African agriculture are indissolubly linked with many others, and they are far too complex to allow of arbitrary answers in simple terms.

39. "It is against this background, and in relation to the vast areas of the Territory and the complexity of problems, that the work of the department among Africans should be viewed. Staff and other considerations have made it necessary to concentrate on the solution of certain outstanding, if local, problems created by rapid land deterioration. This is being achieved, wherever land is available, by planned redistribution of population so as to restore a population-land balance, on the basis of the requirements of traditional land usage.

40. "But the 'chitemene control' and 'resettlement' work goes farther than the mere establishment of a balance which natural increase of population must eventually upset. Improvements in traditional usage, based on knowledge of the systems and the adaptations of which they are capable, have been introduced from the beginning. The assumption is that an evolutionary process of agricultural improvement will keep pace with increase of population, and this process must be guided by experiment. Investigations into the maintenance of fertility without the use of livestock, or with a few small stock, are especially necessary.

41. "In other areas, which include the Tonga Plateau, the old reserves of Fort Jameson, and the as yet untouched problems of the Bangweulu islands, the Luapula valley and the Serenje highlands, no such solution is possible. More or less radical changes in land usage are essential if the land is to continue to carry populations of the present order. These problems are as much social and administrative as agricultural, and the extent to which they can be solved will depend on the degree of co-operation attainable and the resources in men and material which will be available for the future."

Reclamation and Preservation of Native Areas.

(A) SOUTHERN PROVINCE.

42. The demarcation and construction of anti-erosion works in the main native maize-producing area of the railway belt was continued, though on a somewhat reduced scale owing to staff shortage and scarcity of labour. The entire cost of this work (exclusive of European supervision) is met by a grant from the accumulated surpluses of the Native Maize Pool, and the money, which is thus contributed collectively by the native maize growers, is spent on the protection of the land that produced it.

43. In the table below the work completed in 1945 is shown, together with the totals for the five preceding years:

		<i>Acres of cultivated land protected</i>	<i>Miles of contour ridge constructed</i>	<i>Miles of grass strips demarcated</i>
1940-44		44,300	990	101
1945		5,237	147	98
<i>Totals</i>		49,537	1,137	199

The area described as "protected" refers only to actual gardens. A considerably greater area of the countryside benefited from the works which, in addition to the construction of earthworks and the marking of protective strips, included the demarcation of land into arable and grazing areas.

44. All soil conservation works were constructed almost entirely by hand labour, as in previous years, and the average cost, exclusive of European supervision, was again 2.4 pence per yard of completed ridge. The cost of directly protecting one acre of arable land by means of contour ridges averaged 10s. over all the work carried out during the year.

45. Other departmental work in this area included the construction of 33 miles of new road, the repair, drainage and maintenance of a considerably larger mileage of road, and repairs to some of the earlier anti-erosion earthworks in the Kanchomba neighbourhood.

46. An order of the Plateau Tonga Native Authority requires the African cultivators to maintain contour ridges in a state of repair. This order had not been enforced in the Kanchomba neighbourhood and neglect had led to silting and choking of the drains on the steeper slopes and, in some instances, to overflowing and breaching of the banks. Repairs to the damaged area were carried out with the co-operation of the Provincial Administration and Native Authority and with the active assistance of the people concerned. Elsewhere the Native Authority Order operated satisfactorily and the people kept the anti-erosion works in a good state of repair.

47. Another Native Authority Order, introduced last year, prohibits the planting of maize or kaffir-corn after 7th January in any year. The object of this Order is to stop the waste of land caused by planting cereals which have little or no chance of coming to maturity, and to encourage the use of beans as a late-planted crop. In some areas, where rains were late and planting backward, it was found necessary to extend the planting date to 14th January, but the Order has undoubtedly had the effect of stimulating the earlier planting of maize.

48. There was little general improvement in farming methods. Crops were, on the whole, cleaner than usual; there was a slight increase in the amount of kraal manure used and, in some areas, the acreage planted to cowpeas appeared to show an upward trend.

49. The gardens of the "village demonstrators" continued to give visual proof of the degree of improvement which could be attained. On five of these gardens, from which yield measurements were taken, the average yield of maize was 7.7 bags per acre. In the year before improved farming was adopted the average maize yield of these gardens was 1.7 bags per acre. There are 29 demonstration gardens scattered through the maize belt of the Southern Province.

50. A joint socio-agricultural study of seven chieftaincies within the Tonga maize-growing area was made during the year, by a team consisting of the Assistant Director of Agriculture, the Director of the Rhodes-Livingstone Institute, the Ecologist, and an Agricultural Officer. This reconnaissance survey provided a comprehensive picture of the present methods of land holding and land usage in relation to the social structure and the economic resources of the people. A full report on the data obtained, with suggestions as to the means most likely to lead to the much-needed general improvement in agricultural methods, was submitted to Government.

51. One conclusion which emerged from this study is that, in the case of the great majority of cultivators, social factors and lack of material resources limit or prevent the adoption of advanced agricultural methods, and that these difficulties can best be overcome by the development of co-operative farming, with material Government assistance. In order to test the practicability of such a development an experiment in co-operative farming was started with a few volunteers in the neighbourhood of the Monze Station.

(B) EASTERN PROVINCE.

52. In the Eastern Province the method of approach to soil preservation is dilution of population in the congested reserves by planned settlement of the land purchased four years ago, followed by soil conservation and the development of improved methods of land usage within the old reserves.

53. The rate at which resettlement can be carried out is now determined mainly by provision of water supplies, since the remaining areas are largely waterless. During the year twenty additional villages were moved into controlled areas. In the case of nineteen of these villages, with a total population of 2,745, a somewhat modified method of land allocation was adopted. They were grouped into "parishes" of three or four villages, which were settled about the watering points already established, and a single land block was demarcated for each of these groups, instead of allocating a separate block to each village. This method allows of economy in the distribution of watering points, tends to reduce the effect of inter-village movement and, it is hoped, will lead to larger administrative units.

54. The total number of villages moved into the controlled areas is now 292. In addition a considerable number of villages have been allowed to occupy new land without control. The "uncontrolled" area consists mostly of a large extent of escarpment and lower valley country, into which the Ambo and Senga-Kunda peoples have been permitted to move, where control would have been impossible even had it been necessary.

55. Considerable areas still remain unsettled in Petauke District and to the north of Fort Jameson. Settlement of the latter area was delayed owing to danger of sleeping sickness. A barrier road has now been completed, by the Department of Game and Tsetse Control, along the western boundary of the uninhabited land, and it is intended to reduce the "fly" by shooting out game and clearing the "hard pan" (pockets of *Albizzia Harveyi* on compacting pedocal soils, generally near watercourses). Similar operations appear to have given very satisfactory and rapid results in an adjoining settlement area where "fly" was formerly abundant.

56. Supervision of the large area now under agricultural control occupied much of the time of the departmental staff. In the earlier settlements, an elementary system of soil conservation was introduced by demarcating the land for cultivation in contour strips separated by untouched belts of grass

("ten-yardis"). This was followed by an attempt to replace the traditional mound system by cultivation on ridges roughly on the contour and parallel to demarcated "marker" ridges. A system of contour cultivation has now been developed which is proving practical and effective. The "marker" ridges are demarcated at a vertical interval of 2 feet 6 inches and they are gradually converted by the people into broad-based contour banks. In the first year the ridge is built up to a base width of 6 feet and a height of not less than 6 inches, and the base and height are increased each year until the permanent bank, 2 yards wide at the base and 18 inches in height, is completed. At the present time 127 villages are on the "ten-yardi" system, while 165 practise contour cultivation. Villages on the former system can change over to the latter if a majority of the people elect to do so. New villages are allowed to move into the resettlement area only on condition that they accept contour cultivation; they are given 4 or 5 years to adapt themselves to the new system, but in many cases practically the whole of the new gardens are under ridges by the end of the second year.

57. Adaptation of cultivation practice to the new system presents a number of problems. The practice at present advocated is as follows. Stalks and other refuse from the previous crop is burned in the furrow against the upper side of the old ridge. Maize is planted in the ash half-way up the upper side of the old ridge. When the main hoeing is done the new ridge is made against the upper side of the maize plants, the bulk of the soil being moved from the old ridge above. The plants are thus left on the lower side of the new ridge. This method reduces the risk of water-logging, avoids leaving the roots exposed and accelerates the process of bench-terracing. Meanwhile experiments are being carried out on methods of ridging, spacing and planting of crops, and systems of cultivation to be used in conjunction with the ridge system.

58. The second, and more difficult, aspect of the problem—water and soil conservation and the improvement of agricultural practice within the old reserves—remains practically untouched, except for preliminary investigations and propaganda. A large-scale anti-erosion and soil conservation experiment was started in the Ngoni Reserve, with the object of gaining information and providing a pilot area as a guide and demonstration for future work. The villagers were at first reluctant to place their gardens at the disposal of the agricultural staff, and co-operation consisted largely in watching progress, but since the planting season they have shown a greater degree of co-operation in actual field work.

(C) NORTHERN PROVINCE.

59. No extension in the large area now under "*chitemene* control" was made during the year. It was intended to extend the work further into Mporokoso District but this programme had to be abandoned owing to shortage both of agricultural and administrative staff. Three new villages were established in the existing area, bringing the total number of villages within the controlled areas to 238 with a total population estimated at about 20,000 persons. The people are showing a greater willingness to accept control, but the annual demarcation of cutting areas, with the restrictions it involves, is still unpopular and supervision cannot yet be relaxed.

60. The programme of "early burning," adopted as an alternative to the impracticable ideal of complete fire protection of woodland, was continued over an area of 3,300 square miles and, in spite of late rains which reduced the effectiveness of early burning, progress in the control of fires was maintained.

61. Difficulties in preserving a permanent balance between land and population are becoming apparent now that the "*chitemene* control" scheme has been in operation for some years. The maintenance of such a balance obviously involves not only control of land and its use but some restriction on population movement. Constant movements between villages within the controlled area are tending gradually to upset the population-land balance which was established (in so far as the inadequate maps would allow) when control was instituted. It was realised at the beginning that the only available population unit, the village, was too small for effective administration of the scheme and a policy of gradually building larger population units, by amalgamation whenever a village fell below the statutory minimum of ten taxpayers, was adopted. The larger the unit, of course, the more will inter-village movements tend to cancel out, but large villages are apt to be unstable and to split frequently. The solution may be to increase the land unit by amalgamating a suitable number of village areas, and to provide joint cutting areas for the villages within the enlarged land unit. This step would be in conformity with the policy of changing the administrative unit from a village to a "parish," but the problem is not an urgent one and, since even this change will raise fresh problems, it should take the form of gradual evolutionary development.

62. In the *chitemene* areas soil erosion on the main gardens is not a serious problem because of the short cultivation period and the long period of woodland regeneration. Throughout the northern *chitemene* systems, however, the subsidiary village garden is an important institution. These mound gardens are cultivated for longer periods; they are commonly made around the village on the flanks of watercourses, and are subject to erosion. As the area of control was not extended during the year it was possible to give attention to the problem of erosion in village gardens. Contour lines were marked out in all such gardens within the "*chitemene* control" areas (except for 12 villages in Mporokoso District) and along these lines small ridges were constructed by the people and planted with maize and beans. Napier fodder is being bulked at Lunzuwa and it is proposed to distribute planting material through the seed farms, so that the ridges may be planted with the grass and converted into permanent wash-stops.

63. At the seed farms the traditional mounds have been replaced by cultivation ridges approximately parallel to those demarcated on the true contour, but so far the people show a strong disinclination to copy these demonstrations of contour ridge cultivation.

(D) WESTERN PROVINCE.

64. Transfer of population from the congested areas about the Copperbelt was continued on the lines described in the last Report. A further 46 villages were moved into the "resettlement" area. This brings the number of villages moved to 120, and the total area of land which has now been allocated is 289,740 acres.

65. Demarcation of areas for incoming villages involved the cutting of 69 miles of boundary lines, and a large mileage of contour lines was demarcated in the garden areas of the new villages and extensions to gardens of villages previously established. Over 150 miles of road in the settlement area were made up and 15 miles of new road constructed. The departmental building programme, which included housing for African staff, stores and quarters for labour, also took up a good deal of time.

66. Vegetation-soil surveys were completed over a further 50 square miles of country, using parallel straight-line traverses at close intervals. In addition, a survey was made of the proposed loop road for produce buying, from Ndola through the resettlement area and the Lima country to Luanshya. A map was prepared to show distribution of villages and of vegetation-soil types in the area which would be served by the road route.

67. In the last Report the essentially co-operative nature of the Western Province resettlement and development work was stressed. This co-operation was continued during 1945 as far as the straitened staff circumstances of the departments involved permitted.

68. The programme of well construction was completed, and the area is now adequately supplied with water, except for one locality where a dam is required. The central fish dam at Makanga was completed and stocked with Kafue bream, but no further dams were made during the year.

69. The ten test herds of cattle were maintained and periodic inspections were made by officers of the Veterinary Department. Trypanosomiasis appeared at only one kraal, on the Upper Munkulungwe near Bwana Mkubwa, and the presence of tsetse in this neighbourhood has since been detected. Unauthorised movements of cattle through this zone led to the appearance of trypanosomiasis in the southern portion of the Swahili Reserve and at Kambowa and Fivale, but prompt action by the Veterinary Department and treatment of all infected and suspect animals eradicated the infection and prevented further spread. Throughout the main resettlement area there was no occurrence of trypanosomiasis or other diseases in the test herds and "fly" was not recorded. The cattle improved greatly in condition and remained in good condition throughout the dry season. It is reasonably certain that the main settlement area is free of "fly" and well suited to the introduction of stock. At the end of the year the trials were discontinued as they had served their purpose.

70. A District Officer continued to be responsible for the transfer of villages, population counts and general administration of the newly settled area. He supervised the building of a number of "model" villages, part of the plan to make the area attractive to settlers.

71. The main difficulty still is to induce the people to leave the neighbourhood of the Mines, for the "blood, toil and tears" of pioneering is a poor counter-attraction to the comparatively easy if squalid life it is possible to lead on the outskirts of the urban areas. One can but hope that this phase will pass as the communities become established.

72. African towns have now been established at each of the five urban centres on the Copperbelt. These are intended for artisans and others who obtain a livelihood by non-agricultural occupations. In order to restrict and control cultivation and destruction of timber by the inhabitants, a commonage and cultivation plots were demarcated for each of the potential towns by departmental officers. Three half-acre plots, for the cultivation of "relish" crops only, were allotted to each householder, in order to allow of a three-year cultivation period followed by six years of regeneration. This was the simplest method which could be devised, since no means of maintaining fertility other than natural regeneration are available to the plot-holders. It is intended that supervision of cultivation should form part of the normal administration of the townships.

(E) CENTRAL PROVINCE.

73. An agricultural survey of the Serenje District was undertaken, in co-operation with the Rhodes-Livingstone Institute, and the District Commissioner at Serenje. This survey was still in progress at the end of the year.

Improvement and Introduction of Food Crops.

74. In the Northern Province variety trials of selected strains of "male" (*Eleusine coracana*) and work on mosaic-resistant types of cassava were continued at Lunzuwa Agricultural Station. The season was a poor one for "male" on the Station and little further information was obtained from the variety trials of this crop. In the cassava trials the local mosaic-resistant selection C.4 again proved superior to all other varieties under test.

75. The Native Authority seed farms of the Northern Province, which are supervised by the department, again distributed considerable quantities of cassava cuttings, sweet potato cuttings, seed potatoes and seed of maize, kaffir-corn and beans. Seed of butter beans, soya bean, 90-day yellow maize, buckwheat and, at the lower altitudes, rice were supplied to the farms for bulking. These farms obtain most of their planting material from Lunzuwa and it is becoming evident that varieties which do well there are not necessarily best throughout the wide area of the Northern Province. In particular, great difficulty is being experienced in providing mosaic-free cassava stocks at seed farms in Isoka and Chinsali Districts, though the Lunzuwa selections have proved very successful in Abercorn District.

76. A start has been made in improving native food crops in the Western Province, where kaffir-corn is the staple grain. A large number of selections were made from local kaffir-corn in the field. This material was studied by the Ecologist and fourteen distinct types, comprising three different species, were distinguished. These have been planted in observation blocks for bulking and further study.

77. Trials were also made with rice and winter-grown wheat as possible supplementary cereals. The problem in the case of rice is to find a quick maturing type which will give satisfactory yields at the higher altitudes. Trials were continued, on a scatter of plots throughout the resettlement area of Ndola, with Balovale rice of native origin and a very mixed type of unknown origin obtained from Pemba. The average yields for all plots were :

Pemba type	...	...	...	1,457 lb. of grain per acre.
Balovale type	...	...	...	319 lb. " " " "

These plots were grown at an altitude of approximately 4,000 feet. At the even higher altitude of Lunzuwa in the Northern Province, rice again failed to come into grain.

78. Large numbers of fruit-tree seeds and seedlings from Native Authority and departmental nurseries have been distributed in the Eastern and Western Provinces, mainly in the resettlement areas. Distribution continued in 1945. In the Eastern Province the demand for seeds and seedlings decreased considerably, and in both provinces there was little or no improvement in the amount of care given to the young trees. The people are, usually, willing enough to plant fruit trees but very unwilling to give them any attention thereafter. For this reason only the roughest and hardest types of fruit are distributed. In the Western Province, where rough lemon, guava, pawpaw, plantain and mango are used, the survival rate for trees planted in the previous year was about 60 per cent.

Experiments.

79. In the Eastern Province a comprehensive series of experiments was begun. These have as their objects :

- (a) to devise a system of ridge cultivation incorporating the best features of traditional practice ;
- (b) to find methods, within the means of the cultivators, of prolonging the period of cultivation ;
- (c) to find methods, within the means of the cultivators, of reducing the rest period required for soil recovery after cultivation.

Land was prepared and the preliminary experiments planted, but it will be some time before results can be expected.

80. Most of the experiments at Lunzuwa and the seed farms in the Northern Province are designed to test different crop rotations from the point of view of maintenance of fertility and control of weeds, and on these there is as yet little to report.

81. Compost trials on maize have been made over the last three years at Lunzuwa, and all results have now been statistically analysed. These results show that kraal compost undoubtedly improves the yield of maize in the year of application (the gain in yield in the experiments varied from 35 to 75 per cent.), but it is doubtful whether there is any residual effect in the season after application. Kraal compost proved much superior to "green grass" compost as prepared at Lunzuwa. These experiments were repeated with beans as a test crop. "Green grass" compost increased the yield of beans by 75 per cent. and kraal compost by more than 100 per cent., the difference between the two treatments being significant.

82. The effect of compost on "male" remains problematic. It certainly stimulates growth but it has at least an equal effect on the weed "kalolo" (*Eleusine indica*) and yield trials have so far failed to give significant results. The best practice is, probably, to alternate "male" with maize or beans and apply compost to these crops, but there is as yet no conclusive experimental evidence that "male" benefits from the compost applied the year before.

83. At the suggestion of the Joint Development Adviser, small-scale trials of linseed were made in the Northern Province with seed obtained from Uganda and supplied through the courtesy of the Agricultural Department of that territory. The trial was designed to cover the more fertile soil types of the region and plots were planted (a) on red earths near Lunzuwa, (b) on Chipya fringe soil at Lunzuwa, (c) on sandy loams of the granite-sandstone contact at Chibwa. Yields of seed (rain-grown crop) were : (a) 70 lb. per acre, (b) 170 lb. per acre, (c) 160 lb. per acre. Grown as a winter crop under irrigation, on land capable of yielding 1,000 lb. of wheat per acre, the yield of linseed was 324 lb. per acre. The straw was so short and stunted as to be of little value for flax.

84. In the Western Province, the Kambowa Agricultural Station continued to be used for the production of vegetables and fruit to supply the war evacuees camp at Bwana Mkubwa. Experimental work, apart from kaffir-corn selections, was confined to the collection and establishment of grasses which may be of value for pasture and hay or for use as grass leys under local conditions. The following species are now on trial: local—*Paspalum scrobiculatum* var., *Paspalidium* sp., *Pennisetum polystachyon*, *Pennisetum purpureum* var.; introduced—Giant Rhodes grass, Kikuyu, *Paspalum dilatatum*, and strains of Star grass (*Cynodon plectostachyum*) from the Veterinary Laboratory, Mpwapwa.

Agricultural Education.

85. Agricultural education is as yet largely confined to the establishment of school gardens, worked by the pupils, wherever it is possible for the department to give adequate assistance and supervision.

86. Three years ago an additional year of training was interposed in the educational curriculum between Standards V and VI and, as an inevitable consequence, no new teachers graduated from the Senga Hill Agricultural and Teacher Training School in 1945. For this reason only two new gardens were opened in the Northern Province, in addition to the 38 gardens previously established and supervised by departmental officers.

87. The large number of model maize gardens cultivated by schools in the Southern Province, though variable in standard, are, on the whole, giving very satisfactory results. Their main purpose is to familiarise the coming generation of farmers with better agricultural methods, but there are indications that the example of the school gardens is increasingly affecting current practice. The two largest missions now employ their own African agricultural supervisors and this should decrease the amount of departmental supervision required and improve the standard of gardens.

88. In the Eastern Province it has not hitherto been possible to give the same degree of attention to agricultural education through schools, but school gardens are now being established in the re-settlement areas. The two gardens at the Chewa and Ngoni Native Authority schools, especially the former, have reached a high standard and are proving very useful as demonstration centres.

89. Practical educational work is also being started in the Western Province, where six school gardens were opened in 1945. One large garden at the Ndola Farms School, a marginal "fly" area, has now been in cultivation for three years. Fertility has not only been maintained but strikingly improved by keeping a small herd of goats and using intensive composting methods.

Export Crops.

(a) COTTON.

90. Cotton production in the Marambo area of the Luangwa Valley continued to stagnate at the low level of recent years. There were 281 growers and 30,000 lb. of seed cotton were produced. The average receipts per grower were 10s. 9d. The crop cannot compete with the present attractions of abundant employment.

(b) BURLEY TOBACCO.

91. In contrast, the Burley tobacco-growing industry, now well established round Minga, is capable of considerable development provided that the demand for this type of leaf remains reasonably firm. The season was a particularly favourable one for Burley and a record crop of 85,000 lb. of leaf was bought from 579 growers whose aggregate acreage was 230.

92. In order to encourage concentration on quality, a new buying policy was instituted which gave an artificially high price distinction between good and low quality leaf. The range of prices paid to growers was:

Good qualities	...	...	...	...	...	7d. to 10d. per lb.
Average quality	...	...	...	...	...	5d. per lb.
Low qualities	...	...	...	...	...	1d. to 3d. per lb.

The average price paid was just over 4d. per lb. The average receipts per grower were £2 13s. 3d., but several hard-working and skilful men received sums varying from £6 to £25.

93. The grading and packing of the crop proved a difficult matter with the somewhat makeshift accommodation available, in spite of the fact that the grading pit had been doubled in size in anticipation of heavy buyings. Ultimately about 76,000 lb. of leaf were sold over the auction floor at Fort Jameson for £3,500, an average of just over 11d. per lb. The year's working showed a profit of £980, which sum is being reserved for the further development of the industry.

94. The value of the industry to the comparatively small area it covers at present is considerable. Before it was started the area afforded little opportunity to the villager to make an income in his own village. This year the Burley industry resulted in the distribution of £1,540 from the purchase of leaf and a further £720 in wages paid to local labour for the handling of the crop. If only other such developments were possible on a comparable scale throughout the native areas of the Territory one of the most difficult of our economic problems would be within measure of solution.

MAZABUKA,
23rd May, 1946.

C. J. LEWIN,
Director of Agriculture.

FORESTRY

Introduction.

1. Before reporting upon the work carried out by the Forestry Branch in 1945, the opportunity may be taken to review briefly the general condition of forestry in the Territory at the present time. More than one-half of Northern Rhodesia's total area of 290,300 square miles is covered by tree growth. Of this, only a minute fraction is evergreen forest, and that is almost entirely evergreen fringing forest confined to river-banks and small upland swamps. On the other hand, several types of closed deciduous woodland, or deciduous ("monsoon") forest, cover extensive areas. These types have been mapped, in some cases with considerable accuracy, by the Ecological Survey, and by J. D. Martin in Southern Barotseland, but their timber content has not been estimated. Generally speaking, their yields in saw logs are low. The accessible part of these deciduous woodlands now supports the Territory's annual cut of saw timber. With three possible exceptions, development of the less accessible deciduous woodlands seems improbable, owing to their low yields and to the great distances to be covered. But the greatest part of the tree-covered surface of the Territory is a more or less open woodland less than 40 feet high, important to the native inhabitants as the basis of various systems of shifting cultivation, but of little value to any wood-consuming industry.

2. The duties of a forest service in handling such a forest estate fall into two clearly separate categories—timber production for commerce and industry, and protection in the rural areas.

(a) Timber Production for Commerce and Industry.

3. The Rhodesian teak (*Baikiaea plurijuga*) forests of Livingstone-Sesheke districts carry what is probably one of the largest hardwood saw-mills south of the Equator. Production of sleeper timber has been in progress for 30 years and for the past ten years consumption has been at the rate of 3,000,000 cubic feet in the round per annum (about 1,000 logs a day). The mills now employ 130 Europeans and Eurafricans, and 4,000 natives, and, next to mining, are the most important industrial undertaking in the Territory. The forests on which this industry is based cover 500 square miles. The uncut forests, as far as is at present known, appear insufficient to support cutting at the present rate for more than another eight years, perhaps less. The natural resistance of *Baikiaea* forest to fire is broken by exploitation, and the exploited forests can only be kept in existence at all by intensive methods of fire protection—a formidable task in such hot, dry country. The Forestry Branch has devoted the greatest part of its small resources to fire protection. Silvicultural work, especially in relation to methods that could be employed on an extensive scale, is still in an early experimental stage, and no restocking or improvement has been carried out in the 400 square miles already exploited.

4. In the dense woodlands on the Copperbelt a secondary industry has grown up during the war, supplying the copper mines with local *Brachystegia-Isobерlinia* timbers. Fellings by the mines in 1945 totalled nearly 1,000,000 cubic feet of saw logs and heavy poles, and an annual production of 500,000 cubic feet of 9" x 9" x 12' sawn baulks of local timber seems likely to be required by the mining industry permanently in the future. The Copperbelt woodlands have been well surveyed, and two years have been spent on research into the uses of *Brachystegia-Isobерlinia* timbers in mining. The exploitable and accessible woodlands on the Copperbelt contain about 11,000,000 cubic feet of saw logs—possibly 16 years' supply. Positive action is now called for, on an intensive scale, to nurse existing ten-inch pole crops up to saw-log size sufficiently quickly to maintain unbroken the supply of mature timber in the years after that. The policy has been adopted of meeting the industry's requirements from the woodlands on its own doorstep, for the stocking, at four logs per acre, is too low to bear long transport. Twenty-one forest reserves have been selected on the Copperbelt to contribute to this end, and negotiations are at present in progress with the mining companies for the reservation of several hundred square miles of special mining grants which also might be used for timber production. A policy has also been adopted of supplying timber to the mining industry at rates based only on costs of replacement. Government itself is obliged to undertake the whole of the task of forest management, since if it were delegated to the several copper-mining companies, it might be difficult to prevent short-sighted exploitation during periods of depression. Apart from the Copperbelt survey, which was carried out in co-operation with the Northern Rhodesia Chamber of Mines, the Forestry Branch, up to the present, has concentrated its small resources upon preventing damage and waste, and upon early burning in the felled areas. It has been obliged by force of circumstances to postpone indigenous improvement fellings and the establishment of pine plantations to a better-staffed future.

5. One direction in which considerable progress has been made in Northern Rhodesia is in organising supplies of fuel wood and poles for townships and secondary industries. Every principal township in the Territory except Fort Jameson now has a forest reserve upon its boundary, with its fuel supplies arranged under annual cutting plans which are closely controlled. It remains to be seen to what extent a future forest department may be able, by specially organising the cutting and transport, to provide cheap fuel to the large indigent native populations of the townships, on lines of a utility service like an electricity and water undertaking.

6. High-grade furniture woods, joinery woods, and building timbers, at any rate in the industrial areas, are by now in short supply; the Territory has always been too dependent upon imports from the Congo and upon the sideline production of Zambesi Saw Mills. Five forest reserves have been

set aside along the railway line for the purpose of growing mofu (*Entandrophragma*), mukwa (*Pterocarpus*), mupapa (*Azelia*), etc., together with some planting of *Pinus* species, but even when the operations of building up a complete growing stock of these species begins to bear fruit (it has not yet begun), it is almost certain that additional areas farther afield, in Sesheke, Namwala, Petauke, and Fort Rosebery districts, where *Pterocarpus* grows well, will have to be selected and declared forest reserves for growing high-grade timbers on long rotations.

(b) Forestry in Rural Areas.

7. Forestry in the rural areas of Northern Rhodesia has two sides which need to be handled simultaneously. Land conservation is one, and the timber economy of villages is the other. To preserve the forest cover of certain of the Territory's principal headwaters is a matter requiring early attention. The preservation of the headwaters of the Luangwa River (Mafingi Mountain), in Isoka district, is a particular example. Certain regions of steep hillsides are being denuded of their tree growth, to the detriment of the country. Petauke and Fort Jameson have many examples of hillsides that urgently need protection. Stream-side fringing forests are now protected, but in law only. Protection must be applied in fact, for reports from all over the country agree that widespread damage is in progress. Much forest land—the Kasama and the Bangweulu chipyas, and a great part of Barotseland, for example—is in process of permanent deterioration through the effect of bush fires. Its preservation could be secured by varying degrees of protection, and by early burning. Control of bush fires is also necessary over even larger areas of "land not under cultivation" for two reasons, to preserve and to assist regrowth of native timber and, from the agricultural side, to shorten the bush fallow between cycles of shifting cultivation. This restoration of resting lands and forest lands, together with future tsetse-vegetation control, demands a staff of "land policemen," bailiffs or forest guards, for which so far no provision has been made in the forestry staff. It is primarily a duty of local (native) authorities, but amongst these there must be a strong stiffening of personnel from a central forest service for the simple reason that continuity is essential and the objects of the work are too remote to be espoused seriously even by the most progressive local authorities.

8. The large part played by timber in rural economy is seldom appreciated. With a rising standard of living, bush huts built of poles are being replaced by houses which require sawn timber. Sawn timber is even now in demand for clinics, churches, schools, courthouses and similar public buildings. It will be needed for furniture and for carts. Not many districts contain considerable areas carrying timber trees of saw dimensions. Districts like Mazabuka, Mongu, Lusaka, Abercorn, Fort Jameson, are already short of saw timber. The need is to constitute communal forests ("Chiefs' Forests" and "Native Authority Forests") where blocks of land carrying trees of saw-log dimensions will be reserved against shifting cultivation, and used to supply timber to communities or associations of native pit-sawyers, carpentry craftsmen, and artisans, at cheap rates, or, when possible, at no cost at all. Particular forest belts, in Kawambwa, Fort Rosebery, Petauke, Namwala, and Southern Barotseland, appear capable of supporting small local African factories where furniture could be prefabricated for transport and sale to the industrial areas—an aspect of rural development so far not investigated.

9. In addition to forest blocks, it is an accepted policy that individual trees of specially valuable species (mukwa, African mahogany, saninga, etc.) must be protected wherever they grow, to be felled and used only after they have attained mature dimensions. This is provided for under the Forests Ordinance, though not in native reserves. It needs translating into practice, for the law is now more often broken than observed. Minor forest produce bulks very largely in domestic rural economy. Wild fruits, dyes, nets, bark cloth, honey, beeswax, oil seeds (to mention only a few items) depend upon the maintenance of forest conditions; so does the supply of canoes, spoons, mortars, paddles, and similar wooden utensils, which are almost always made of some special wood. Martin, in *Report on Forestry in Barotseland* (p. 1) and Trapnell (*Ecological Survey, North-Western Rhodesia*, p. 64) give accounts of a considerable interior trade in wood products in Barotseland and reveal a surprising degree of dependence of the Barotse upon their forests. Audrey Richards (*Land, Labour and Diet in Northern Rhodesia*, pp. 230–31) gives a vivid description of how the Bemba, at the opposite end of the Territory, depend completely upon their forests and are in effect "forest-dwelling Bantu." A stable trade in forest products between villages which produce them and villages which do not can only be assured for the future by preventing waste and exhaustion of the raw materials.

10. The duties outlined above, namely :

- (a) the protection of streams and escarpments,
- (b) the fire control of special types of woodland and of "resting" agricultural savannah,
- (c) the establishment of communal forests for saw timber, and
- (d) the maintenance of supplies of special woods and minor forest products,

are as much the concern of the Agricultural Officers who are now busy reorganising the peoples' shifting cultivation, and of Administrative Officers, as of a forest service acting on its own. The greater part of the duties must eventually devolve upon local Native Authorities, who can and in many cases already do, provide the necessary legal sanctions under Native Authority laws, each code suited to the requirements of its own region. To give effect to these laws, the policy is to build Native Authority forest services upon a basic African staff seconded from the Government forest service. But it must be admitted that the immediate tasks in the difficult initial stages are too large, too costly, and the benefits too remote, to be appreciated by local Native Authorities. The Government forest staff required to

persuade, advise and supervise may have to be as large as if Central Government undertook the duties directly.

11. Apart from offering some advice to Administrative and Agricultural Officers, and the late J. D. Martin's start (before the war) upon reorganising the indigenous forestry system of the Paramount Chief of the Barotse, the small forestry branch in Northern Rhodesia has so far not undertaken any forestry work in the rural areas.

War Record.

12. Even a brief review of forestry at the present time would not be complete without reference to the effects of the war. When the war broke out it found Northern Rhodesia with a forestry section of the Department of Agriculture, staffed by three Assistant Conservators and three Foresters, much occupied in a revenue hunt with which to justify projected expansion. One Assistant Conservator of Forests departed on active service immediately, and was followed a year later by another, and then by a Forester, leaving the staff of Northern Rhodesia's forest service at one Assistant Conservator of Forests, and two Foresters, much of whose time was taken up with internal defence duties. This relict staff proceeded to execute a forestry Dunkirk. The unsuitable Forests Ordinance of 1925 was withdrawn and a completely new one written and brought into force, together with Forest Licence Regulations. The African staff was increased, placed on fixed grades, and given clearly defined duties. An administrative framework was devised into which rapidly increasing war-time fellings in the industrial areas were fitted and kept under control. At the same time research and experimental work was kept up to date, and boundaries and communications in forest reserves were improved. The complicated and difficult question of rights to free timber under the mining law was tackled, and the relevant sections of that law were revised suitably. Few small forest services can point to a record of such able administration in such adverse circumstances.

13. Meanwhile the demand for timber grew rapidly. Defence buildings absorbed very considerable quantities, particularly of poles, but as complete records were not kept (indeed, there was no staff to do so) it is hard even to estimate the figures. By 1943 defence demands slackened, only to be replaced by equally great demands for public works and African housing. At this time Northern Rhodesia was felling, in saw logs alone, considerably more than any other East African territory. Zambesi Saw Mills soon reached its maximum capacity of 3,000,000 cubic feet a year, and maintained that consumption of Rhodesian teak with little change throughout the war. The copper mines, stimulated to full production and deprived by shortage of shipping of their customary supplies of Douglas fir, began to use the *Brachystegia-Isobertlinia* woodlands on their properties for mining timber, exhausted these, and commenced cutting in earnest on adjoining Crown Lands. An Assistant Conservator of Forests was withdrawn from the army in 1942 to deal solely with this problem. Saw-mills were erected at each mine, seasoning and preservative techniques were established for the local timbers, and in the last two years of the war nearly 2,000,000 cubic feet of local timber was used for copper mining, at a cost appreciably lower than that of imported wood before the war. At the same time, consumption of imported Douglas fir and pitch-pine on the mines was reduced from an average of 400,000 cubic feet to an indispensable 100,000 cubic feet in 1945. A large-scale enumeration survey of the Copperbelt was also carried out with the assistance of the Northern Rhodesia Chamber of Mines in 1943-44, using a staff of geologists and surveyors borrowed from the mining companies, and all the exploitable and accessible timber was mapped over the Copperbelt area of nearly 2,000 square miles.

14. The end of the war found the forest service, under the Director of Agriculture, with a staff of two Assistant Conservators (the third had been killed), and two Foresters, one temporary Forester, and one part-time assistant, and an African staff that had been nearly doubled. The demand for forest produce from all quarters had become more insistent than ever, and was kept in check only by lack of machinery and transport. Local timber for mining and for African housing had by then assumed the shape of a permanent demand, and a strong demand had developed for timber for export to South Africa for as long as the shipping shortage continues. This has produced a considerable pressure upon all the Territory's accessible timber resources. Meanwhile 100 square miles of Rhodesian teak (*Baikiaea*) forests, cut out and not restocked, and 50 square miles of *Brachystegia-Isobertlinia* woodland exploited during the past five years, remain a war-time debit against silvicultural work of the future.

15. In passing, some reference should be made to the collection of revenue during the war. Forest produce throughout that time was sold by licence at the same very low rates that were in force before the war, considerable issues for defence works or to Government departments were free and in many cases not recorded, and sales were never made to mining companies or other consumers by auction or with reference to the current market prices of timber. Thus, although the revenue collected exceeded the expenditure (its forest service over the past three years has cost Northern Rhodesia nothing), the surplus was not large. Apart from accumulating £17,000 in the Barotse Forest Fund from the exploitation of Rhodesian teak, no opportunity was found to build up a reserve from surplus revenue from Crown Lands as has been done in Kenya during the past few years.

16. With this brief review as a background, the work of the Forestry Branch in 1945 may now be reported. The year was devoted mainly to administration. Very nearly the whole of the energies of the small and war-jaded forestry staff were given either to protecting the exploited Rhodesian teak forests from fire or to directing fellings in the industrial districts in such a way that they might do the least permanent damage to useful forest areas.

The Forest Estate.

17. The following new forest reserves were gazetted during the year :

Ndola Forest Reserve :

Government Notice No. 95 of 1945 added an abandoned mining grant, very well stocked with *Brachystegia utilis*, to the existing Ndola Forest Reserve 1,300 acres.

Lukanga Forest Reserve :

This extensive block of uninhabited country, lying along the railway line west of Kapiri Mposhi, and on the headwaters of the Lukanga River, will be used mainly as a future source of supply for mining poles to Broken Hill mine. By far the greater part of it is *Isobertinia* scrub, too poor to exploit, and useful in the future only as protection forest 79,000 acres.

Chingola Forest Reserve :

An area of dense *Brachystegia utilis* woodland, on the edge of Chingola township, reserved for the purpose of supplying that town, and Nchanga mine, with poles and fuel 7,000 acres.

Total 87,300 acres.

18. The area of forest reserves in Northern Rhodesia now totals 775 square miles (639 in 1944), or 0.26 per cent. of the Territory's total area.

19. The following protected forest area was constituted in Government Notice No. 126 of 1945 :

Machili Protected Forest Area :

This covers the most important group of Rhodesian teak (*Baikiaea plurijuga*) forests, in the middle of which Zambesi Saw Mills' sleeper-mill (Mulobesi) is situated. These forests have all been exploited, and now require protection against man, animals, and (most particularly) fire. Although lying outside Barotseland, the forests belong in certain respects to the Paramount Chief, and rights to cut trees free of charge for canoes, or to enter the area in search of honey or game, have been preserved to nominees of the Paramount Chief or of the Mwandi Kuta. Area—119,438 acres.

20. The Territory's protected forest areas now cover 190 square miles (3 square miles in 1944), or 0.06 per cent. of the total land surface of the Territory.

21. In the course of the year under report, a review was made of the copper-mining industry's requirements of local timber. Twenty-one forest reserves on the Copperbelt were selected, and proposed for reservation. Discussions were also conducted with Mufulira copper mines and with the Northern Rhodesia Chamber of Mines in order to bring several hundred square miles of special mining grants (which carry an important part of the industry's future timber supplies) under legal protection as protected forest areas, and under the full control of the Forestry Branch, in a manner that would permit of their being incorporated in a unified plan for supplying the mining industry. Arrangements had been all but concluded by the end of the year.

Reconnaissance, Survey and Management.

22. Further reconnaissances were made in the *Baikiaea* forests in the extreme south-west of Barotseland (and of the Territory as a whole) near the Mashi River, which separates Northern Rhodesia from Portuguese West Africa. It was found that, although on a vegetation-type map the extent of these forests would be considerable, that picture would be misleading. Most of the forests examined appeared very promising on first approach, as entry was made into a well-stocked fringe with a normal mutemwa understorey. Generally within a quarter of a mile, however, the character of the forest changed to scattered mukusi trees with, in place of the mutemwa thicket, a short (three-foot-high) bushy undergrowth. The forests were, moreover, extremely broken, and the determination of the amount of timber contained in the fringes of these "shell" forests would involve a more lengthy and thorough survey than their inaccessible situation would justify at present. On the other hand the mixed woodlands containing *Pterocarpus*, *Baikiaea*, *Ricinodendron rautanenii* and *Copaifera coleosperma*, which stretch along the common frontier of Northern Rhodesia and the Caprivi Strip (South-West Africa), were found to be of sufficient extent and quality to offer possibilities for commercial exploitation. A proposal to that end was under consideration at the end of the year.

23. A hasty reconnaissance was carried out in a large unoccupied area of Crown Land lying north of the farming belt at Chisamba and extending to the Mwombashi River. A still more rapid survey, lasting only three days, was conducted in the Karubwe Crown Lands, south of Chisamba. Both these blocks of country contain belts and pockets of sandy loam with bush of the "transitional" and "chipya" types, often with dense thickets of undergrowth, in which scattered mofwe (*Entandrophragma*) and mukwa (*Pterocarpus*) grow well. Draft proposals were submitted for reserving both of these very extensive areas for forestry. As, however, the same area was found to contain good land for growing both Virginian and Turkish tobacco, the proposals were shelved pending the report of the Select Committee on Land Settlement, and a re-survey in greater detail.

24. Detailed plans of operations were drawn up covering all phases of the year's work at each centre on the railway belt. They included prescriptions for fellings (saw timber, poles, firewood and headloads), for early burning, for boundary clearing, for roadmaking, for buildings, and for tending experimental areas, and it is pleasing to record that at every centre all the important prescriptions were satisfactorily carried out. In addition to the definition of felling areas ("coupes"), 520 miles of forest reserve boundaries were cleared and hoed, 130 miles of bush roads and bridle or cycle paths were constructed, and 10 miles of other permanent patrol paths were opened and cleaned. Buildings completed were 20 Government type II African houses (11 in 1944), 3 permanent rest-camps, and 19 standard labourers' huts.

25. In the course of the year, control over the cutting of forest produce was improved at each of the centres where organised fellings are in progress. The year's coupes, or felling areas, were demarcated by hoed lines and were surveyed by chain and compass. Forest Guards stood over the cutting in every coupe to see that it was carried out according to the forest licence regulations, and African Forest Rangers checked licences, counted and measured the produce felled, and submitted regular monthly returns. When it is understood that a centre such as Lusaka had four different kinds of felling area, widely separated (and Kitwe, Ndola and Luanshya five each), and that organised felling was in progress at 10 different centres almost throughout the year, it will be appreciated that administrative duties alone taxed the capacity of the staff to the limit.

26. Fellings and other operations in the Rhodesian teak forests exploited by the Zambesi Saw Mills were controlled by a staff of 14 Forest Rangers and Guards. A squad of these men went ahead of the felling gangs and marked all trees to remain as seed-bearers and others, which, although above the normal girth limit, could be reserved under a special clause of the agreement as being wasteful to cut at their present size and condition. Another squad followed in the rear of the exploitation and classified all trees over 20 inches girth left in the forest. Others supervised the disposal of slash and the haulage of logs (to prevent damage to remaining trees), and recorded utilisable timber not removed, for which the company was called upon to pay.

Protection.

27. The early part of the dry season was exceptionally cold. Frost damage was marked in the eucalypt plantings done by the Health Department on the swamp fringes at Ndola. Frost noticeably affected the range of early grass fires, particularly at Broken Hill, where the grass in a great part of the forest reserve was scorched, and it burned so fiercely at normal early-burning time that special gangs had to be taken out to clear adjoining farm boundaries and to protect these farms by counterfiring.

28. The dry season took heavy toll of ndunga (*Maesopsis eminii*) on the Copperbelt. Six experimental plots of this species between their fifth and seventh years died back nearly to ground-level. One-year-old *Callitris calcarata* and four-year-old *Pinus patula* also suffered severely. It is worth remarking that all the trees died quite suddenly after the first few thunderstorms, and that this phenomenon of sudden death from shock as the rains break after a specially dry season has been noted in previous years, even in the case of small plantings of indigenous species.

29. Fire protection (and with this is included early burning) occupied an important part of the year's programme. In the exploited and other accessible Rhodesian teak forests of Livingstone and Sesheke districts complete fire-protection of almost 500 square miles of forest was carried out. Of this total, 45 square miles were protected by the exploiting company, 286 square miles of exploited forest were handled under direct departmental control, and 165 square miles of unexploited forest were entrusted to native forest indunas. The last are generally local headmen who recruit their own labour force to early-burn the savannah and grassland surrounding the unexploited teak forests before the latter are dry enough to be readily inflammable. The expenses of these gangs and a variable amount of supervision are provided by the department. The forest indunas serve as fire-watchers in their own areas throughout the rest of the dry season and muster local inhabitants in the event of an outbreak of fire. The system is complete in itself for unexploited forests, and is especially useful in that the people living in the vicinity of the forests are made aware of the importance attached to fire-protection and of the need for care throughout the dry season.

30. In the exploited Rhodesian teak forests much more thorough and stringent measures are required, as the opening of railway and other haulage lines through the dense bushy undergrowth and the amount of slash and debris left throughout these forests makes them both more exposed and more vulnerable to fire damage. A system of open belts, based on the railway lines and loading stations made during exploitation, provides internal fire-breaks, on which the grass and other vegetation is burned to a width of 40 or 50 yards early in the dry season. Cleared paths are, however, required along the edges of these belts as well as around the forest, and the maintenance of more lines as access roads is important. Search was made to find methods more economical in such clearing than hand-hoeing or the dragging of a heavy thorn branch behind a team of oxen. At the present time these lines total over 500 miles in length in the Machili and Sesheke forests, and an adequate system of breaks and roads would involve a much higher mileage. A favourable season and intensive supervision and patrolling, especially in the semi-mutemwa forests around Katombora, which suffered damage in the previous years, were responsible for the exploited forests entirely escaping damage in 1945. There were only three reports of fires which threatened the forests (one at Katombora and two in Sesheke district), but all were extinguished on the boundaries.

31. In the rest of the country complete fire protection was carried out in four forest reserves only, *i.e.*, round the experimental plots, and on four large dambos (water meadows) covering many square miles, where the grass was needed by Government departments and other bodies for thatch for their new building programmes. Wide outer fire-breaks and internal cut-offs did not prevent half of Chichele dambo being burned (with damage to three test plots of *Eucalyptus* species in the middle of it) and all Sibulwa dambo in Luanshya Forest Reserve.

32. For the rest, in the forest reserves and felling areas in the northern half of the country, early burning was carried out instead of complete fire protection. Intensive early burning in the exploited woodland is as much a silvicultural operation (for it encourages regrowth) as a protective one, and should be more properly recorded under that head. Casual early burning was carried out according to plan in each of the unexploited forest reserves (total about 350 square miles) and also on roughly 200 square miles of Crown Lands. (Early burning in 1944 covered roughly 200 square miles.)

33. The number of reported forest offences showed an increase, due chiefly to increased staff and supervision. In the urban centres a system has been evolved in which Forest Guards or Rangers fill in a printed charge sheet and take African offenders directly to the Native Urban Courts, where the wrongdoers are very satisfactorily fined by their peers without the intervention of a Forest Officer. The number of cases dealt with in this fashion during 1945 has not been recorded, but it certainly exceeds 200. Cases handled by rural Native Authorities have not been recorded either—it is thought that they were very few.

Silviculture.

34. In felling areas the provisions of the Forest Licence Regulations (which oblige licensees to clear up crownwood and stack it more than six feet away from any useful growing tree) were adequately enforced. Heaps of branchwood were burned before they became too dry, and grass and slash in the coupes was burned lightly to forestall late fires. Areas cut over during the past five years, and particularly those areas which had been clear felled and were now filled with coppice regeneration amongst a dense growth of grass, were early-burned in a number of stages. The effect of this treatment in assisting natural regrowth was most marked. Slash and early burning in 1945 coupes covered approximately 8,000 acres. Intensive early burning in regrowth areas, *i.e.*, areas under regeneration, covered approximately 21,000 acres.

35. In addition, on Luansobe Grant (Mufulira area) and on Buchanans' West (Nkana area) two coupes, each of about 1,000 acres, were selected, the dry crownwood left from the previous year's logging was piled and burned, and the circular patches of ash were sown "Rab" fashion with seed of *Brachystegia hockii* (= *B. spicaeformis*), *Isobertinia tomentosa*, *Erythrophloeum africanum*, and some *Azelia* and *Pterocarpus*. Germinations at the end of the year appeared promising.

Research.

36. The test plots of *Pinus* species, near Ndola, mentioned in previous annual reports, were maintained. No new planting was carried out. *P. insularis*, *P. patula*, *P. "teocote"*, *P. leiophylla* continued to show good growth, and *P. montezumae*, *P. Khasya*, *P. Engelmannii* and *P. palustris*, though slower, maintained their healthy appearance. *P. longifolia*, *P. taeda* and, to a less extent, *P. caribaea* showed a spurt of growth after six to nine years of repression. *P. ponderosa* and the maritime pines (*P. radiata* = *insignis*, *P. pinaster*, *P. pinea*, *P. canariensis*) continued, as in previous years, to exist but not to grow. It would be wrong to give the impression that the problems of raising pine plantations on the Copperbelt have been mastered, but it is felt that sufficient experience has been gained in the course of 12 years' experimental plantings at Ndola to justify planting on a larger scale.

37. Of other species in the test plantation at Ndola, *Gmelina arborea* showed rapid growth, averaging five feet in height per year; *Maesopsis eminii*, as already reported, all died back at the sudden break of the rains, which were late; the slow-growing plot of *Afrormosia angolensis*, 12 years old, and two indifferent plots of *Cupressus lusitanica* (10 years old) showed definite improvement; spot-sown *Erythrophloeum africanum*, aged 12 years, after very necessary pruning, gave a regular and well-stocked stand 20 feet high. Line plantings of indigenous species under natural woodland, made ten years ago, upon review showed themselves to be an economic failure.

38. The research plots in *Isobertinia-Brachystegia* woodland were maintained. It was not found possible to work up past data or to make fresh remeasurements.

39. Experimental work was, however, resumed in the Rhodesian teak forests after having been, of necessity, completely neglected since the beginning of the war. The sample plots and marked seedlings in Situmpa Forest, of which the first records were made seven years previously, were remeasured. Unfortunately it was found that many of the labels and marks had disappeared, and much of the value of the original measurements has been lost. From the regrettably small number of records that are considered reliable, it was possible to frame the first statistical outline of the growth and development of *Baikiaea plurijuga*. It appears that, apart from outright death, the seedlings of mukusi have, like many other native trees, a habit of dying back for no very apparent reason and then resuming growth from the root-stock. Over 50 per cent. of the seedlings whose career can be followed over the seven-year period have either died completely or died back in that time. Amongst the remainder that have made uninterrupted growth, the mean annual height increment is only two inches in the smaller classes, slowly rising to between five and six inches as the seedlings reach six feet in height,

by which time it would appear that they must be already 20 years of age. The available records of girth increment show an almost equally slow rate of growth in later life, and even trees between 15 and 45 inches girth, which might well be expected to cover the stage of most vigorous growth, have an average girth increment of less than half an inch per annum.

40. Further measurements were begun to determine the period of the year in which *Baikiaea* makes its growth, the rate of growth of coppice shoots, and the response of such regrowth to the thinning and cleaning out of surplus shoots. Small trials in the transplanting of mukusi seedlings, both as stumps and in their natural state, were also started. Another effort at direct sowing of mukusi in mutemwa forest was again a complete failure as rodents and baboons destroyed all the seeds and seedlings.

41. Specimens of a dozen local plants were sent to New York Botanic Garden for analysis—they contained alkaloids or febrifuges—and a useful report was obtained from South Africa upon the tannin content of a consignment of bark taken from several local tree species. The *Isoberlinias*, particularly *Isoberlinia paniculata*, gave better values than the *Brachystegias*.

42. In utilisation, advice on seasoning and preservative treatment was given to the copper-mining companies, but research work was confined to inspecting and measuring a series of preservative and durability tests that had been started underground in three of the mines at the end of 1943.

Land Planning and Co-operative Projects.

43. A reconnaissance party under a Forester and subsequently under an African Forest Ranger carried out strip enumeration surveys in five blocks of *Pterocarpus* bush in Petauke district, and produced an estimate of 20,000 logs (about 200,000 cubic feet) of sound exploitable mulombe (*P. angolensis*) in these blocks alone. Questions of selling them for export, or of erecting a local mill and woodworking factory to utilise this and other supplies in the region, were deferred pending the legal constitution of Native Trust Lands. The areas actually surveyed had already been allocated in part to villages, under the scheme of agricultural resettlement which is in progress in that district. A senior African Forest Ranger and a Forest Guard were posted to Petauke and placed under the orders of the District Commissioner. Rules were promulgated by the Native Authorities for the protection of young mulombe (*Pterocarpus*) trees, for early burning, and for the salvage of *Pterocarpus* logs felled in the resettlement area, in the course of clearing village gardens. The District Commissioner made very good use of the forest staff at his disposal in helping these Authorities to enforce their new forest rules. Fully 1,000 *Pterocarpus* logs were salvaged, measured, and collected. Twenty pit-saw units of the Public Works Department started work in Petauke at the end of the year, and the District Commissioner drew up a project for a centralised sawing and woodworking organisation for supplying *Pterocarpus* to other Government departments as well.

44. Meanwhile fairly full directions were given to the Agricultural Officers responsible for mapping and classifying the resettlement blocks, on how to select areas to be withheld from settlement and how to choose forest reserves for supplying the agricultural communities with saw timber for the future. It was also arranged that larger areas, suitable for national forest reserves, would be chosen by the Agricultural Officers and set aside for demarcation when forestry staff could be made available for the purpose.

45. A fairly full report was obtained from the District Commissioner, Luwingu, on trial plantings of *Eucalyptus* species on the treeless island of Ncheta in Lake Bangweulu. Two Luwingu nurserymen, who had been given a short course at Ndola in raising trees, were sent back to him for this duty. Their efforts were a qualified success. Losses due to inexperienced planting, and to flooding and a high water table, amounted to about 65 per cent. of plantings, but the Native Authorities were sufficiently impressed with the value of the work to vote £115 from their local treasury to continue the operations in 1946.

Production and Trade.

46. The demand for all classes of forest produce exceeded the means of supply—that is, it was not met—because of the shortage of transport, saw-milling machinery, and tools. The removal of timber from the list of exports under licensing control brought a record number of inquiries for timber for export to South Africa; a number of applications were received for concessions, ranging from ten-year large-scale concessions in Petauke and Kawambwa, to requests for a few truckloads of native timber from the Copperbelt. No concessions were granted. The long-term applications were shelved, pending the constitution of Native Trust Lands, and the others were dealt with by normal licensing under the Forests Ordinance. Belgian restrictions upon timber exports from the Belgian Congo reduced our supplies from that country by 66 per cent., and our small purchases from Portuguese East Africa fell by a similar percentage; these factors, combined with increased building programmes, made joinery and building timbers scarcer even than in previous years.

47. Zambesi Saw Mills Ltd. took 3,032,000 cubic feet of timber from the forests of Sesheke District (2,900,000 cubic feet in 1944). Of this total, 2,884,000 cubic feet were cut in Sisisi Forest and consisted almost entirely of Rhodesian teak or mukusi (*Baikiaea plurijuga*), less than .5 per cent. being mwangura (*Pterocarpus stevensonii*) and other species. From 17 square miles of Sisisi Forest proper, 2,550,000 cubic feet were taken (=236 cubic feet per acre), and 328,000 cubic feet in an outlying patch of partially destroyed forest, about three square miles in extent (=170 cubic feet per acre). A further

148,000 cubic feet, of which 76 per cent. was mukwa (*Pterocarpus angolensis*) and the rest largely *Brachystegia spiciformis*, were cut in an area of woodland to the north-west of Sisisi Forest, into which the company's standard-gauge railway-line was carried. During 1945 the company was able to complete the change-over, begun before the war, from oxen to caterpillar tractors for the haulage of logs from the forest to the railway tracks. As well as dispensing with the large numbers of oxen previously maintained, this and the use of a bull-dozer in the clearing of railway formations resulted in an appreciable saving of native labour, which was none too plentiful during the year. The average number of persons employed by the company during the year was 107 Europeans, 15 Eurafricans, and 3,509 Africans.

48. The output of sawn timber from the company's mills at Mulobezi and Livingstone amounted to 1,073,000 cubic feet (990,000 in 1944), and was composed of the following :

Rhodesia Railways' sleepers	...	429,000 cu. ft.	...	All <i>B. plurijuga</i>
South African Railways' sleepers	...	132,000	..	All <i>B. plurijuga</i>
Mining timbers	...	210,000	..	90% <i>B. plurijuga</i>
Flooring	...	63,000	..	{ 70% <i>B. plurijuga</i> 30% <i>Pt. angolensis</i>
Furniture and joinery	...	10,000	..	{ 55% <i>B. plurijuga</i> 45% <i>Pt. angolensis</i>
Handles and wheel parts	...	1,000	..	{ 80% <i>Pt. stevensonii</i> 20% <i>B. spiciformis</i>
Miscellaneous	...	228,000	..	70% <i>B. plurijuga</i>

49. Rhodesian Wood Industries, Ltd., of Livingstone, cut throughout 1945 on Crown Land and Native Reserve in the vicinity of Katombora. They obtained there 72,000 cubic feet of timber (80,000 in 1944) which, with another 1,000 cubic feet imported from Portuguese East Africa, enabled them to produce 16,000 cubic feet of plywood and veneers (15,000 in 1944). Handicapped by lack of adequate plant since their start early in the war period, this firm obtained and installed during 1945 a hydraulic press, two re-driers, and other accessory machines which enabled the quality of their products to be improved. They employed throughout the year an average of three Europeans, five Eurafricans and 200 Africans.

50. The copper mines made some further improvements in their saw-mills and in their technique of seasoning and impregnating mining timbers. The effect of improved technique is beginning to make itself felt in the longer lasting qualities of underground timber, and it is possible that this is the reason why consumption of local mixed mutondo (*Brachystegia-Isoberlinia*) was not much larger in 1945 than in 1944. As in the previous year, a major part of the mines' requirements was cut under licence on Crown Lands, and the rest—mining poles and firewood especially—was drawn from the various companies' own properties. The following figures, showing the amount of round timber felled by each company under licence from the Forest Office, do not therefore give a proper picture of the quantity of local timber used by the mines. Volumes are in cubic feet.

	1945	1944
Roan Antelope	181,613	232,385
Mufulira	116,037	130,025
Nkana	365,740	318,174
Nchanga	71,521	109,245
Union Miniere (including poles)	101,785	48,800
Broken Hill (including poles)	142,383	—

Once again, the costs of logging and extracting the above supplies comprised the greater part of the cost of the finished product, owing mainly to a lack of proper logging equipment. About one-half of Nkana Mine's supplies were cut on the railway line at Walamba (80 miles from the mine) ahead of the shifting cultivation of the people who were moving in under an agricultural resettlement scheme.

51. In addition to fellings by the mines, there was plenty of activity in pit-sawing at the principal inhabited centres. Here the demand for furniture and joinery timber noticeably exceeded the supply. African pit-sawyers had no difficulty in selling all their output ; each sawyer was restricted to five trees per month of the reserved species (the scheduled rate per tree for these varies from £1 for a *Pterocarpus* or a *Khaya* tree to 7s. 6d. for a *Faurea*, and 4s. for unreserved species). Most pit-sawyers worked on contract for Europeans or Indian traders, though a minority devoted themselves to supplying the growing needs of the newly created African towns. At a rough guess, there were 80 pit-saws at work round the seven main townships at any one time during the year. The number working at missions and on outstations cannot be guessed. It became clear that on the Copperbelt at least, the supply of *Pterocarpus*, *Albizzia*, *Faurea*, *Khaya* and *Entandrophragma* trees is approaching exhaustion, and that the community of African pit-sawyers, with its dependent carpenters, is going to be hard put to it in future years to make a living, for *Isoberlinia tomentosa*, which is more plentiful, is very susceptible to attack by Bostrychid and Lyctid wood-boring beetles, and makes an indifferent substitute for the above-named resistant species. Besides pit-sawing, one new saw-mill and two woodworking shops were started on the Copperbelt during the year, mainly for the production of joinery and building timber for local consumption.

52. Poles sold from Crown Lands under licence were 35 per cent. more than in 1944. Broken Hill Mine used 11,000 *Isobertinia paniculata* poles for mining, and the Public Works Department used over 30,000 poles for buildings in two African suburbs alone. These were felled under supervision of the Forestry Branch. A very much larger number of poles, unfortunately not recorded, was taken free from Crown Land by Public Works Department for its compounds and roads.

53. Firewood licences issued by the department rose by nearly 40 per cent. on the 1944 figure. Brick-burning for larger building programmes accounted for much of this increase. It was possible to dispose of some of the branchwood and crownwood left behind in four of the mines' logging areas by selling it on estimate at very cheap rates. The recorded figure of 61,000 cords sold under licence in 1945 of course in no way represents the quantities consumed, even in the principal townships, since unrecorded amounts of wood were sold from farms and private lands, and, in any case, it is legal for any person to take his own domestic requirements from Crown Land free of charge. Despite this, and despite the proximity of forest reserves devoted to fuelwood production, selling prices for firewood were high, reaching £1 per cord (of 128 cubic feet stacked) in at least three townships. Africans at Kitwe, Lusaka and Broken Hill complained to Labour Officers of difficulties in obtaining sufficient fuel for their household needs—difficulties which seem likely to increase in the future unless a better system of transport can be organised.

54. The Zambesi Saw Mills handled some 6,600 skins in the tannery which is an adjunct of their Livingstone mill, and in which the sole source of tannin is sawdust of *B. plurijuga*. This tannery was much expanded when it could not satisfy the demand for its products. In 1945 production of leather amounted to nearly 60 tons.

55. Appendix I shows the quantities of forest produce sold under licence in 1945 by the Forestry Branch, and the amount of revenue collected during the year.

Imports and Exports.

56. The returns shown in Appendices IIA and IIB have been extracted from Customs records. The values shown for imports are those in the country of origin : they exclude transport, insurance, handling and agents' charges, and they therefore give little indication of the price paid inside the Territory for the delivered product.

57. It is hardly possible to present a clear picture of the Territory's balance between imports and exports. Round logs and poles amounting to 101,785 cubic feet were exported from Kipushi Forest Reserve to the Union Miniere du Haut Katanga in the Congo ; about 23,000 cubic feet of sawn joinery timber was imported from the Lower Congo into Northern Rhodesia. Many of the sleepers produced by Zambesi Saw Mills were turned over to Rhodesia Railways at Livingstone (which is on the border), but they were used in Southern Rhodesian sections of the railway as well as in Northern Rhodesian sections. Some indication of the nature of the Territory's export trade is given in the following figures of amounts exported by Zambesi Saw Mills under export licences (timber control) between September, 1944, and August, 1945.

						Cubic feet, sawn
Rhodesia Railways' sleepers	...	...	...	...	...	464,495
South African Railways' sleepers	...	...	...	...	...	53,530
Mining timbers	...	...	...	...	...	213,054
Flooring	...	...	...	...	...	13,644
Furniture and joinery	...	...	...	...	...	16,916
Handles, spokes, etc.	...	...	...	...	...	2,556
Miscellaneous	...	...	...	...	...	225,870
<i>Total</i>	...	...	...	...	...	990,065 cubic feet

58. Imports consisted principally of Oregon pine, together with some pitch-pine, which was required for special purposes by the copper mines. The marked drop in imports of joinery timbers from the Congo has been noted in a previous section. Exports consisted mainly of Rhodesian teak sleepers or flooring wood, with a smaller amount of mukwa (*Pterocarpus*) chiefly in a manufactured condition. Towards the end of the year Northern Rhodesia was exporting furniture and joinery timber to its southern neighbours, and yet, being short of these timbers inside the Territory, it was importing similar timber, or manufactured furniture, from them.

59. Minor forest produce, such as beeswax and rubber, was not handled by the Forestry Branch.

Expenditure and Revenue.

60. The expenditure and revenue of the past ten years is given in Appendix IIIA. Appendix IIIB gives particulars of expenditure and revenue under the Barotse Forest Fund over the same period.

Expenditure, 1945.

61. Expenditure of funds provided under Head 8, Agriculture, from the Territory's annual revenue, was as follows :

	Actual Expenditure, 1945 £	Authorised, 1945 £	1944 £
Personal emoluments	4,429	6,680	5,456
Travelling allowances	173	314	248
Travelling on leave	333	230	298
Transport—general	1,181	1,453	969
African staff—rations	601	775	774
African staff—uniforms	492	543	356
Equipment and seeds	258	262	150
Labour	2,395	2,450	1,700
Temporary buildings	318	100	330
Motor vehicles	481	630	900
Enumeration survey of Copperbelt Forests	375	400	1,000
Tents and camp equipment	69	108	—
	<u>£11,105</u>	<u>£13,945</u>	<u>£12,181</u>

Actual expenditure was below the authorised expenditure for the year, as the European staff was four officers below strength, and most of the other items were affected accordingly. The figures given for actual expenditure are subject to correction by the Accountant-General. The expenses of the Director of Agriculture as Chief Forest Officer, and of his headquarters' accounting staff, are not included.

62. Expenditure from the Barotse Forest Fund totalled £1,578. It was spent as follows :

	£
African staff, salaries	344
African staff, rations and uniforms	284
Transport	85
Equipment	77
Labour (mainly fire protection)	345
Cost-of-living allowances	186
Fire protection by forest indunas	147
Buildings	110
<i>Total</i>	<u>£1,578</u>

63. No expenditure was made from any loan funds.

Revenue, 1945.

64. The revenue collected and recorded by the Forestry Branch from licences for forest produce was as follows :

	1945 £	1944 £
Forest Reserves	2,854	} 12,989
Crown Lands	9,762	
Barotse Forest Fund	5,718	5,050
Natives Reserves Fund	713	303
Free issues	996	1,805
	<u>£20,043</u>	<u>£20,147</u>

(These figures are given subject to correction by the Accountant-General.) The value given for free issues does not present a proper picture of the amounts of wood which actually were cut free. Apart from the forest produce taken by the native inhabitants in their tribal areas (far exceeding in quantity that felled in the industrial districts), and apart from that taken by both Europeans and Africans on Crown Land in the exercise of their general right to forest produce for household furniture or domestic use, free of charge, the greater part of the fellings by Public Works Department and, in fact, by all public bodies off the line of rail, went unrecorded.

65. A standing grant of free timber to missionary societies and religious bodies dates back to the early stages of the Territory's history. It became necessary to review this long-established custom during the course of the year. It was found that the best timbers, particularly mukwa (*Pterocarpus*) were being exploited free of charge by many missions under conditions leading to considerable waste, and for purposes hardly in accord with the objects of the free grant. It was arranged that missions requiring timber should apply to the nearest District Commissioner for free licences to cut specific amounts, and that they should be under obligation to prove the necessity for these amounts, particularly with reference to the reserved species, of which mukwa (*Pterocarpus*) is the most important.

Staff.

European Staff.

66. The duties of Chief Forest Officer were carried out, as in previous years, by the Director of Agriculture.

67. One Forester resigned during the year, and one Assistant Conservator was promoted, leaving the position at the end of the year as follows :

						<i>Authorised Establishment,</i>		<i>Actual</i>
						1945		
Senior Assistant Conservator	...	...	...	...	...	1		1
Assistant Conservators	...	...	...	...	...	3		1
Senior Forester	...	...	...	...	...	1	...	—
Foresters	...	...	...	...	...	5	...	2
Temporary Forester	...	...	...	...	...	—	...	1
Assistant Forester (part-time only)	...	...	...	...	...	—	...	1
						—		—
<i>Totals</i>	...	...	...	...	...	10	...	6
						==		==

A part-time stenographer and clerical assistant was also employed at Ndola ; there were three changes in the holder of this post. Leave, and illness, brought it about that one Assistant Conservator was obliged to run the whole of the forestry affairs of the Territory for two months, without even office assistance.

68. Proposals were made by the Southern Rhodesia Government for a two-year training course in forestry for men leaving the armed forces, and it was eventually agreed that four Northern Rhodesia Government nominees should attend the course. This would ensure the recruitment of four fully trained Foresters in 1948. Advertisements were published in the Press at the end of the year inviting applications.

African Staff.

69. The establishment of African Forest Rangers was increased from 33 in 1944 to 40 in 1945. These are Graded African Civil Servants, on the same rates of pay as African clerks. It was not found possible, owing to shortage of teaching staff, to give Forest Rangers any training ; applicants were merely given six months' apprenticeship as labourers or as Forest Guards before engagement. In addition to a very high rate of wastage at the apprenticeship stage (caused by an insistence upon physical work), three older and experienced Forest Rangers resigned and one was discharged. At the end of the year the establishment was six men below strength.

70. The year showed once again that the responsibilities forced upon African Forest Rangers are too great for them to carry without much more European supervision. They are usually young Africans of indifferent education, and of no proper technical training ; and it is surprising that their varied duties round the industrial centres (issuing licences, allocating felling areas, managing the work in forest reserves, making out pay vouchers and paying labourers, measuring the submitting records of all forest produce felled at their centres, arresting and charging offenders under the Forests Ordinance, etc.) are performed at all, considering that they receive only a few visits from a European officer in the course of a year, and little help from any other source.

71. The number of Forest Guards was increased from 58 to 68. There were plenty of applicants, including a high proportion of youths fresh from school with Standard IV or V certificates. All the northern division candidates were given six or eight months' manual work at Ndola nursery and experimental plantation, the best of those passing through this filter being posted out as Forest Guards when vacancies occurred. Wastage from resignations and discharges was much lower in the case of Forest Guards than in the case of Forest Rangers, and the staff was only four men below strength at the end of the year. Early in the year every Forest Guard in the northern division was called in and put through a fortnight's intensive training course at Kitwe and in Nkana Mine's logging areas ; this produced a clearly marked improvement throughout the division, and it is thought that refresher training courses of this type should be repeated annually.

72. Towards the end of the year recruitment of the African staff was stopped, to allow of the absorption of askari from the three battalions returning from active service outside the Territory.

Legislation.

73. The following legislation was passed during the year under report :

Ordinance No. 9 of 1945. Amendment to the Mining Proclamation, 1912. This obliges the registered holder of a mining location to pay the cost of forest regeneration upon land within any of his locations from which he takes wood or timber.

Government Notice No. 96 of 1945. The Mining Proclamation, 1912. This lays down the conditions under which indigenous forest produce may be cut by holders of registered mining locations upon unalienated Crown Lands open to prospecting which have not been declared forest reserves or protected

forest areas. Holders are obliged to observe the felling rules laid down under the Forests Ordinance, and to pay at least the costs of regeneration.

Ordinance No. 27 of 1945. Amendment to the Forests Ordinance. This amends the wording of section 7 of the Forests Ordinance of 1942 and clarifies the position of the native inhabitants in Native Authority areas.

Government Notice No. 116 of 1945. Amends the Forest Licence Regulations suitably for application to Barotseland, and allocates revenue from forest licences in Barotseland to the Barotse Native Treasury.

Government Notice No. 95 of 1945. Ndola Forest Reserve.

Government Notices Nos. 113 and 139 of 1945. Lukanga Forest Reserve.

Government Notices Nos. 125 and 126 of 1945. Machili Protected Forest Area.

Government Notices Nos. 183 and 207 of 1945. Chingola Forest Reserve.

Miscellaneous.

74. This report has been written in collaboration with the Assistant Conservator of Forests, Livingstone.

C. E. DUFF,
Senior Assistant Conservator of Forests.

APPENDIX I.

SUMMARY OF FOREST PRODUCE CUT UNDER LICENCE, 1945.

	Timber (Cubic feet)		Poles (Number)		Firewood (Cords of 128 stacked cu. ft.)		Revenue Collected (£)		
	Crown Lands	Forest Reserves	Crown Lands	Forest Reserves	Crown Lands	Forest Reserves	Crown Lands	Forest Reserves	Total
Ndola and Kipushi	9,062	57,136	17,594	23,754	1,487	9,928	299	1,013	1,312
Luanshya and Roan Antelope Mine	192,813	18,249	433	2,209	4,594	11,193	1,701	624	2,325
Kitwe and Nkana Mine	412,888	—	6,075	—	7,294	1,137	3,440	45	3,485
Mufulira and Mufulira Mine	122,665	—	38,384	—	4,351	241	1,609	44	1,653
Chingola and Nchanga Mine	76,006	—	2,433	—	1,850	—	1,043	—	1,043
Broken Hill and Broken Hill Development Company, Limited	7,044	—	71,205	2,025	5,988	1,395	899	110	1,009
Lusaka	44	149	393	2,363	—	6,973	3	624	627
Livingstone	45,228	—	5,800	—	74	3,883	694	394	1,088
Other Districts	6,640	—	250	—	4	—	74	—	74
	872,390	75,534	132,567	30,351	25,642	34,750	9,762	2,854	12,616
Combined Totals Crown Lands and Forest Reserves	Cubic Feet 947,924		Poles 162,918		Cords 60,392		£ 12,616		
Zambesi Saw Mills (Barotseland)	3,042,000		—		—		5,718		
Native Reserve XV, Livingstone and Lenje Native Reserve	34,209		3,626		600		713		
Free Issues—All Districts	19,339		50,196		233		996		
GRAND TOTALS	4,043,472		226,740		61,225		£20,043		
Equivalent in Long Tons	109,283		12,256		91,838		.		

APPENDIX IIA.

IMPORTS OF WOOD, ETC., TO NORTHERN RHODESIA.

Year	Wood Unmanufactured												Total Class X (including canes, corks, brush-ware)
	From Canada				From U.S.A.				From Europe				Total Wood Imports
	Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value	
		£		£		£		£		£		£	Value
*1945	129,550	21,156	—	—	—	—	67,975	16,616	11,051	3,349	212,072	43,129	£
1944	166,117	31,623	41,396	—	—	—	77,612	15,955	10,558	2,859	297,624	60,749	89,688
1943	132,405	23,657	76,005	—	—	10	87,873	15,363	5,532	1,451	317,077	92,427	98,125
1942	176,746	26,822	48,879	—	—	208	80,750	12,253	7,201	2,232	320,176	58,835	152,605
1941	427,722	41,949	24,865	—	—	7,849	70,388	11,382	3,213	845	579,518	72,097	127,539
1940	309,706	17,620	19,374	—	—	12,592	30,070	5,008	14,800	1,774	501,542	42,727	149,231
1939	295,374	17,213	26,858	—	—	13,076	8,817	1,150	5,180	694	519,567	42,415	108,006
1938	321,037	24,439	44,452	—	—	10,184	29,303	4,458	1,580	219	764,458	58,034	106,739
1937	111,760	5,416	6,289	—	—	3,708	3,347	1,701	19,555	1,544	759,628	35,679	106,414
1936	96,507	5,705	84,149	—	—	4,063	5,161	1,076	15,960	1,654	273,795	24,392	51,080
1935	147,819	8,470	121,906	—	—	11,103	24,174	3,894	3,983	734	430,702	41,294	45,359
1934	155,988	10,503	41,238	—	—	3,987	75	21	23	4	432,215	29,264	69,018
1933	—	—	—	—	—	—	—	—	—	—	—	—	45,832
													48,092

* Complete figures not available at the time of compiling this Report.

APPENDIX IIB.

EXPORTS OF WOOD, ETC., FROM NORTHERN RHODESIA.

Year	Rough Wood and Fuel	Wood Unmanufactured						Partly Manufactured (Flooring, Ceiling, etc.)			Railway Sleepers Value			Joinery	Furniture	Veneers	Other Manufactures (Incl. Handles and Plywood)	Total Wood Exports (including Re-exports etc.)	Total Northern Rhodesia Produce only
		To S.R.		To Union		To Congo		Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value	To S.R.	To Union	Total	Value	Value	Value
		Cu. Ft.	Value	Cu. Ft.	Value	Cu. Ft.	Value												
1944	£ 1,801	38,831	8,467	104,178	£ 21,558	—	—	143,009	£ 30,025	14,470	5,346	21,686	79,753	£ 107,022	£ 348	£ 1,165	£ 4,856	£ 176,432	£ 165,855
1943	1,709	34,066	8,146	102,914	21,515	—	—	136,980	29,661	17,866	6,731	64,206	58,486	122,692	1,086	549	27,760	195,806	187,949
1942	781	44,379	9,246	307,201	46,979	—	—	355,488	57,104	15,432	6,161	49,986	19,230	68,216	1,265	606	11,178	145,311	144,805
1941	119	43,635	7,258	291,264	37,416	—	—	334,899	44,674	12,449	4,630	86,735	8,201	94,936	672	474	1,099	147,304	146,163
1940	83	24,563	3,671	185,654	16,495	8,272	105	218,489	20,271	10,638	2,745	43,629	27,776	71,405	30	522	1,652	96,137	96,137
1939	192	43,690	5,808	379,724	34,088	35,944	446	459,358	40,342	31,685	6,224	23,260	37,051	60,411	556	365	1,967	110,557	109,392
1938	329	48,041	6,613	358,090	33,903	31,723	351	437,854	40,867	27,575	4,327	94,138	33,045	127,183	320	807	2,431	176,264	174,814
1937	802	39,950	6,576	374,693	32,001	36,887	447	454,252	39,365	14,406	3,347	33,853	67,206	101,059	545	733	2,410	148,261	147,695
1936	—	26,101	3,945	305,309	26,954	88,959	556	420,584	31,498	2,141	776	13,376	94,257	107,633	110	996	1,937	142,950	142,628
1935	—	39,507	5,320	228,100	20,629	—	—	267,710	25,964	5,542	2,247	2,232	72,244	74,476	138	428	1,677	104,330	104,043
1934	—	27,803	4,406	182,301	16,406	28	11	210,409	20,903	8,340	1,245	3,275	36,282	39,557	79	1,039	1,351	64,174	63,106
1933	—	18,738	3,421	56,757	8,209	—	—	75,505	11,634	777	309	189	31,102	31,291	347	6,222	4,538	54,341	—

NOTE.—Complete figures for 1945 were not available at the time of compilation of this Report.

APPENDIX IIIA.

FORESTRY EXPENDITURE AND REVENUE 1935-1945.

Year	EXPENDITURE			REVENUE		
	Actual Expenditure (under Agricultural Department Vote)	Barotse Forest Fund	Total (Expenditure to nearest £100)	Crown Lands and Forest Reserves	Barotse Forest Fund	Total including recorded free licences and sales by Forest Department from N. Reserves (to nearest £100)
	£	£	£	£	£	£
1935	3,540	—	3,500	1,104	—	1,300
1936	3,250	1,346	4,600	1,345	19	1,400
1937	3,593	1,387	5,000	1,789	1,652	3,600
1938	4,666	1,290	6,000	1,902	2,191	4,400
1939	6,122	770	6,900	2,593	440	3,100
1940	5,126	850	6,000	2,285	4,826	7,500
1941	4,590	870	5,400	4,007	4,644	9,100
1942	5,952	850	6,800	3,870	5,530	9,800
1943	7,194	1,079	8,300	9,648	5,184	15,400
1944	11,566	1,236	12,800	12,989	5,050	20,100
1945	11,205	1,578	12,800	12,616	5,718	20,000

NOTE.—The figures for expenditure do not include any part of the Director of Agriculture's expenses in his capacity as Chief Forest Officer, nor any part of the salary of his headquarters' accounting officer.

APPENDIX IIIB.

SUMMARY OF REVENUE AND EXPENDITURE UNDER BAROTSE FOREST FUND 1936-1945.

Year	Revenue	Forestry Expenditure	Paid to Barotse Treasury	Total Outgoings	Balance available for funding
	£	£	£	£	£
1936 ...	18	1,345	—	1,345	— 1,327
1937 ...	1,652	1,387	375	1,762	— 110
1938 ...	2,191	1,290	750	2,040	+ 151
1939 ...	440	770	750	1,520	— 1,060
1940 ...	4,826	850 *	750	1,600	+ 3,226
1941 ...	4,644	870 *	750	1,620	+ 3,024
1942 ...	5,530	850 *	750	1,600	+ 3,930
1943 ...	5,184	1,079	750	1,829	+ 3,355
1944 ...	5,050	1,236	750	1,986	+ 3,064
1945 ...	5,718	1,578	750	2,328	+ 3,390
Net total at 31st December, 1945, exclusive of interest					+ £17,623

* Detailed figures of actual expenditure not available : these figures are estimates.